THE RELATIONSHIP BETWEEN SHORT-TERM MEMORY AND
THE PHONETIC TRANSCRIPTION ACCURACY OF SPEECH AND
LANGUAGE THERAPY STUDENTS.

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ABSTRACT
Currently, little is known about the many factors which might affect the accuracy of phonetic transcription. This study investigated the potential role of phonological short-term memory on the transcription accuracy of students. Sixteen second year speech and language therapy students completed a test of phonological short-term memory, the results of which were then compared to their marks in formal phonetics assessments. Strong positive correlations were found between the measure of phonological short-term memory and transcription marks. This preliminary study suggests that phonological short-term memory may be a limiting factor on transcription performance and implications for teaching and learning, and clinical practice, are considered.

Keywords: transcription, short-term memory

1. INTRODUCTION
This work tests the assumption that phonetic transcription accuracy may be limited by a transcriber’s phonological short-term memory. Transcription is a complex cognitive-motor skill which requires the transcriber to translate an incoming speech signal into the symbols of the International Phonetic Alphabet (IPA) and its extensions (ExtIPA), so that a permanent record is available for subsequent evaluation and analysis.

Transcription is crucially important for many professionals including general linguists and speech and language therapists, who often use it daily in their work in the assessment of clients, whereby transcriptions often represent a first step in planning therapy [1]. In terms of student education, students must achieve a high standard in transcription in order to progress through their degrees and into the workplace.

Whilst in some fields transcription is aided by recordings, and displays of waveforms and spectrograms, much clinical transcription occurs without these aids. In addition, much student education focuses on transcription by ear alone, and it is live, unaided transcription that is the focus of this paper.

There is, as yet, no complete model of the transcription process, although in order to hypothesize what skills and abilities are used during transcription, we can consider the stages a person goes through when they transcribe. A transcriber must first attend to the material, hear it, and see it if there is a visual component. They must then store (all or part) of the incoming signal temporarily in memory, whilst segmenting it, identifying each putative segment by comparison to an internal store of sounds, and translating each of these sounds into the appropriate IPA symbol, which is then written down ([2]). So far there has been relatively little research investigating which factors affect transcription accuracy, but presumably features at any stage of this process can affect the accuracy of a given transcription.

Accuracy is a difficult concept in assessing transcription, because as [1] note, different transcriptions may be functionally equivalent. Here we use a limited definition of accuracy, referring to transcriptions of items produced by a trained phonetician, who has practiced them several times, and for which another phonetician’s transcriptions agree highly with the target.

This paper concentrates on the potential contribution of temporary memories of verbal material to the accuracy of phonetic transcription. Phonological short-term memory is generally described as the capacity for holding a small amount of information in an active state for a short period of time. It can be conceived of as a short-term store of phonological representations which decay over time unless they are refreshed by articulatory rehearsal (see e.g. [3] and subsequent revisions). One might predict that, during the transcription of verbal material, transcribers must use their phonological store to maintain material
for long enough to transcribe it, whilst also segmenting the material and accessing stored auditory representations and symbols. Therefore, if a person can store more material, or if the material is stored more accurately, one would expect to find that their transcriptions are more accurate than those of an individual whose store is not as efficient at maintaining verbal material.

We investigated the research question, ‘is there a relationship between phonological short-term memory and the transcription accuracy of student transcribers?’ We hypothesized that transcription accuracy would be positively correlated with a measure of phonological short-term memory, and that this type of memory would be a limiting factor in transcription performance.

2. METHOD

2.1. Design

The experiment used a within-subjects design, where all participants completed all tasks. Participants’ scores on a test of phonological short-term memory were compared to their marks on formal phonetics assessments. The memory test and phonetics assessments were conducted and scored by different researchers, each blind to the other set of results until the end of the academic year, in order to avoid bias.

2.2. Participants

Sixteen second-year undergraduate speech and language therapy students at a metropolitan university in the United Kingdom participated. Students had studied transcription for three terms so were not novice transcribers, but simply practicing an already acquired skill. The focus was on student transcribers, rather than expert phoneticians, because variability is required in transcription scores if we are to address the relationship between memory and transcription accuracy, and wide variation is unlikely to be found in an expert population. More importantly, as we ultimately aim to make recommendations to lecturers and students for improving transcription, it makes sense to focus on this group.

Participants were all female, and aged between 19 and 53 (mean: 26.9, mode: 19.0), which is a broad reflection of the typical student speech and language therapist demographic in the UK. No student reported any history of speech, language or hearing difficulties. None of the participants was dyslexic, however one was awaiting the results of a dyslexia assessment. One participant had English as an additional language, and another was trilingual from birth. The rest were monolingual.

All students from the year group who volunteered were included, regardless of age, and number of languages spoken, in the hope of the results providing a true representation of the general population of speech and language therapy students. Participants were not paid, or given course credit for their time.

2.3. Materials and procedure

Phonological short-term memory was assessed using the digit span test from the Wechsler Adult Intelligence Scales-Revised Edition (WAIS_R) ([4]). Participants were assessed individually in quiet rooms within the university. The test was administered according to the WAIS-R instructions, saying the digits live at one per second, not grouped, with pitch dropping on the last digit of each series (the series denotes the number of digits in an item). Participants repeated the digits spoken by the experimenter either forwards or backwards. The test consisted of two trials of each series length, (from 3 to 9 digits for forwards, and 2 to 8 digits for the backwards test) and was discontinued after failure on both trials of any series length. Participants were awarded one point for each correct repetition, with a maximum possible total of 28, 14 for forwards and 14 for backwards digit span.

Transcription accuracy was assessed using results from three formal phonetics assessments. These assessments were spaced across the year and became progressively harder by using longer and more complex items for transcription and a wider range of IPA sounds. The assessments included a number of subcomponents, covering different types of transcription (phonemic, allophonic, nonword and pseudo-clinical) as well as some exercises not focusing on transcription proper (namely labelling, symbolising and substitutions). We hypothesised that the marks for the transcription-based subcomponents would be positively correlated with memory scores, whilst the marks for those subcomponents not involving transcription would be unrelated to memory scores.

The normal arrangements for phonetics assessments were in place. Thus students were tested together in their usual teaching room, by their usual phonetics lecturer. Thirty-two students...
were in the cohort, but results are only presented for those 16 who consented to take part in this research and completed the short-term memory test. Students received 8 to 10 repetitions of every item for transcription, from various locations in the teaching room, and did not have access to any revision notes, lists of symbols or IPA charts. The lecturer monitored the students to ensure they did not collaborate.

All dictated material was audio-recorded at the time of the assessments and later transcribed by an expert phonetician (who had not seen the targets) as a reliability check. In the rare cases of deviation from the target, student transcriptions were marked correct if they matched either the target or the transcription of the expert phonetician.

Student responses were marked following the usual procedures in place at the institution. In the results below, four marks are reported, expressed as percentages. For each of the three phonetics assessments a mark is provided which comprises only the transcription based subcomponents. The fourth mark is that for the subcomponents which were not based on transcription, comprising two substitution exercises (from assessments 1 and 2) and a labeling and symbolizing exercise (from assessment 1), which we hypothesize are unrelated to phonological short-term memory.

3. RESULTS

In order to demonstrate the range of the data, scatter plots are shown below in figures 1 and 2. Figure 1 shows the relationship between phonological short-term memory, as measured by digit span, and transcription accuracy in each assessment, whilst figure 2 shows the relationship between digit span and the subcomponents of the assessments that were not based on transcription.

Figure 1: The relationship between digit span and transcription marks

![Figure 1: The relationship between digit span and transcription marks](image)

Figure 2: The relationship between digit span and non-transcription marks

![Figure 2: The relationship between digit span and non-transcription marks](image)

One tailed Pairwise Pearson’s correlations were conducted between the digit span score and the four phonetics assessment marks, as shown in table 1. As is typical when using correlations, coefficients of 0.40 to 0.59 were regarded as indicating moderately high correlation, values of 0.60 to 0.79 as indicating substantial correlation, and values of 0.80 and over as indicating outstanding correlation.

Table 1: Pairwise correlations between digit span and marks in the formal phonetics assessments. ** is a significant correlation at the 0.01 level.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transcription 1</td>
<td>.668**</td>
</tr>
<tr>
<td>Transcription 2</td>
<td>.605**</td>
</tr>
<tr>
<td>Transcription 3</td>
<td>.759**</td>
</tr>
<tr>
<td>Non-transcription</td>
<td>.146</td>
</tr>
</tbody>
</table>

The three transcription scores correlated substantially with digit span. There was no significant correlation between digit span and the measure derived from the non-transcription subcomponents of the phonetics assessments.

4. DISCUSSION

The findings of this preliminary study indicate that there is a strong relationship between a measure of phonological short-term memory and the transcription accuracy of student speech and language therapists. There were strong positive correlations between digit span and the marks for the transcription components of three formal phonetics assessments. This indicates that phonological short-term memory may be a limiting factor in transcription performance.
It is notable that the score for the non-transcription subcomponents of the phonetics assessments did not significantly correlate with digit span. This suggests that the strong correlations between the transcription scores and digit span are not due simply to a third factor such as general IQ or academic readiness.

The finding that phonological short-term memory might indeed impact upon transcription accuracy has a number of implications for pedagogy and for clinic. [2] suggests that student transcriptions improve with more repetitions because, when a stimulus is too long to be remembered in its entirety, different sections can be attended to across repetitions. If this is the case, then students with poorer short-term memory should benefit more from extra repetitions than those with greater memory capacity. Those with poorer short-term memory will only be able to store shorter sections of incoming material, or will store material less accurately, and will therefore need more repetitions to ‘step-through’ the stimulus. Whilst it is not appropriate to give different numbers of repetitions to different students, it may be possible to suggest different strategies according to memory and transcription abilities [5]. In addition, it should be noted that any decision to reduce the number of repetitions given in assessments might disadvantage some students more than others.

If these results can be extended to practicing clinicians (which seems entirely possible), then therapists who struggle with transcription may wish to record their client’s productions so that they can be transcribed after hearing them more than once (although there is still debate about whether multiple presentation facilitates or hinders accuracy and reliability, see e.g. [2], [6], [7]).

Future work should investigate if programmes to improve phonological short-term memory can impact on transcription performance (cf. [8]), and explore the effect of other underlying processes on transcription accuracy. If a person has difficulty with transcription it may be because they cannot remember or segment the signal, or be due to one of many other factors such as difficulty with symbols, or lack of time spent building up representations of non-native speech sounds. All these factors, and the relationship between them, will need to be investigated for a full understanding of the factors which affect accuracy.

5. CONCLUSION

In sum, our preliminary study suggests that phonological short-term memory is crucial for accurate transcription, involving as it does recall of stimuli which must be manipulated and converted into symbols. This work represents a first step in identifying which skills and abilities underlie transcription, and it is hoped that from this we can go on to further investigate short-term memory and other relevant skills, using multi-factorial studies which investigate causal links between transcription accuracy and its underlying processes. Further investigations of the skills underlying transcription will ultimately allow us to better understand transcription as a multifaceted cognitive process, and allow those involved in teaching and learning to help students and clinicians become better transcribers.

6. REFERENCES


7. ACKNOWLEDGEMENTS

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